

CLAIMS

1. A hollow fiber membrane type fluid treatment device comprising at least a body portion of tubular housing containing a hollow fiber membrane bundle; a housing head portion which is connected with one end of the housing body portion and has a resin layer where the hollow fiber membrane bundle is fixed by using a resin composition, and a connection port which serves as a treatment liquid inlet; a housing head portion which is connected with the other end of the housing body portion and has a resin layer where the hollow fiber membrane bundle is fixed by using a resin composition, and a connection port which serves as a treatment liquid outlet; header caps attached to these housing head portions and having a treatment target liquid connection ports, respectively; characterized in that the fluid treatment device has at least a diameter-expanding portion which is provided to an inner surface of a treatment liquid inlet side in the tubular housing and enables the hollow fiber membranes to be disposed so that a distance between the hollow fiber membranes is gradually increased toward an end face of the treatment liquid inlet side.
2. The hollow fiber membrane type fluid treatment device according to claim 1, wherein the diameter-expanding portion comprises a baffle plate provided at a position corresponding to the treatment liquid inlet of the tubular housing and interspatially from an inner circumference of the tubular housing over the entire inner circumference at a curvature almost along the inner circumference, and the baffle plate gradually increases in diameter toward the end face of the housing.
3. The hollow fiber membrane type fluid treatment device according to claim 2, wherein the hollow fiber membrane bundle is arranged so that the

distance between the hollow fiber membranes is gradually increased toward the end face on the inlet side along the increased diameter of the baffle plate.

4. The hollow fiber membrane type fluid treatment device according to claim 2 or 3, wherein the end portion of the baffle plate has a shape curved along the circumference inside the resin layer.

5. The hollow fiber membrane type fluid treatment device according to any of claims 2 to 4, wherein an angle formed by the centerline of the tubular housing and the inner circumferential surface of the baffle plate is greater than 0 degree and smaller than the angle defined by $\tan^{-1}\{1/2 \cdot (d_1 - d_3)/L_3\}$ (where, d_1 is the diameter of the hollow fiber membrane bundle at an end face of the resin layer, d_3 is an inner diameter of the tubular housing at a joint portion between the body portion and the head portion, and L_3 is a height of the baffle plate).

6. The hollow fiber membrane type fluid treatment device according to any of claims 2 to 5, wherein an angle formed by the centerline of the tubular housing and the inner circumferential surface of the baffle plate is greater than 1° and smaller than $\tan^{-1}\{1/2 \cdot (d_1 - d_3)/L_3\}$ (where, d_1 is the diameter of the hollow fiber membrane bundle at an end face of the resin layer, d_3 is an inner diameter of the tubular housing at a joint portion between the body portion and the head portion, and L_3 is a height of the baffle plate).

7. The hollow fiber membrane type fluid treatment device according to any of claims 2 to 6, wherein the baffle plate has a height of 2 to 12 mm.

8. The hollow fiber membrane type fluid treatment device according to any of claims 2 to 7, having a urea clearance of 191 to 200 ml/min.

9. The hollow fiber membrane type fluid treatment device according to any of claims 2 to 8, having a drop leakage occurrence rate determined by a drop impact test of 3/10 or less.

10. The hollow fiber membrane type fluid treatment device according to any of claims 2 to 9, wherein at least the inner surface of the housing body portion on the treatment liquid inlet side comprises a body straight portion and an end tapered portion which increases in diameter toward the end face of the housing body portion.

11. The hollow fiber membrane type fluid treatment device according to claim 1, wherein the diameter-expanding portion comprises an end tapered portion which increases in diameter toward the end face of the housing body portion; and the inner surface of the housing body portion on the treatment liquid inlet side includes a body straight portion.

12. The hollow fiber membrane type fluid treatment device according to claim 11, wherein the hollow fiber membrane bundle is arranged so that the distance between the hollow fiber membranes is gradually increased toward the end face on the treatment liquid inlet side along a taper of a tapered portion of the inner surface of the housing body portion.

13. The hollow fiber membrane type fluid treatment device according to claim 11 or 12, wherein the tapered portion comprises a first tapered portion located on the body portion side, and a second tapered portion located on the treatment liquid inlet side, and the angle of the first taper angle is smaller than the angle of the second taper angle.

14. The hollow fiber membrane type fluid treatment device according to any of claims 11 to 13, wherein an angle formed by a centerline of the inner surface of the housing body portion and an inner surface of the end tapered portion is greater than 0° and smaller than an angle defined by $\tan^{-1}\{1/2 \cdot (d_1 - d_4)/L_4\}$ (where, d_1 is the diameter of the hollow fiber membrane bundle at an end face of the resin layer, d_4 is an inner diameter of the straight portion or minimum diameter portion of the body portion, and L_4 is the length (one side) of the end tapered portion which increases in diameter toward the end face of the housing body portion).

15. The hollow fiber membrane type fluid treatment device according to any of claims 10 to 14, wherein an angle formed by a centerline of the inner surface of the housing body portion and an inner surface of the end tapered portion is greater than 0.58° and smaller than an angle defined by $\tan^{-1}\{1/2 \cdot (d_1 - d_4)/L_4\}$ (where, d_1 is the diameter of the hollow fiber membrane bundle at an end face of the resin layer, d_4 is an inner diameter of the straight portion or minimum diameter portion of the body portion, and L_4 is the length (one side) of the end tapered portion which increases in diameter toward the end face of the housing body portion).

16. The hollow fiber membrane type fluid treatment device according to any of claims 11 to 15, wherein a ratio of the length of the body straight portion to the total length of the end tapered portion is 0.7 to 20, and a ratio of the inner diameter of the end tapered portion on the end face side to the inner diameter of the body straight portion is more than 1 and not more than 3.

17. The hollow fiber membrane type fluid treatment device according to any of claims 11 to 16, having a urea clearance and a vitamin B12 clearance of 191 to 200 ml/min and 135 to 170 ml/min, respectively.

18. The hollow fiber membrane type fluid treatment device according to any of claims 11 to 17, comprising baffle plates provided at positions corresponding to the treatment liquid inlet and the treatment liquid outlet of the tubular housing and interspatially from the inner circumference of the tubular housing over the entire inner circumference at a curvature almost along the inner circumference .

19. The hollow fiber membrane type fluid treatment device according to claim 18, wherein the baffle plate gradually increases in diameter toward the end face of the housing.